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PATENT SPECIFICATION

Convention Date (Sweden): April 2, 1931. **378,489**

Application Date (In United Kingdom): May 8, 1931. No. 13,680/31.

Complete Accepted: Aug. 8, 1932.

COMPLETE SPECIFICATION.

Improvements in or relating to Power Transmission for Motor Vehicles.

I, BIRGER LJUNGSTRÖM, of Linnegatan 83, Stockholm, Sweden, a subject of the King of Sweden, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to power transmissions in motor vehicles having the engine and encased gearings built together as a unit, wherein the driving power for the driving wheels of the vehicle is transmitted from the middle portion of said unit, reckoned in the direction of the engine crank shaft. The object of the invention is to design a power transmission which, as regards possibilities of location and compactness is well suited for such engine gear units, particularly in their employment for front wheel drive.

The invention is mainly characterised by the fact that below or beside the engine shaft or its protraction there are disposed two transmission shafts parallel to the engine shaft, whereby under all driving conditions the driving power from one end of the engine shaft is transmitted to one of the said shafts, the primary shaft, and by means of a power transmission, for instance a toothed gearing, provided between said shafts, is transmitted through the other of said shafts, the secondary shaft, and a final pinion to a final gearing located at the middle portion of the engine gear unit, reckoned in the direction of the engine shaft, from which final gearing the engine power is transmitted to external transmission members, the driving shafts and the driving wheels, said final pinion being secured to that end of the said secondary shaft, which is directed inwardly towards the middle portion of the engine gear unit.

The invention is more closely described below under reference to the accompanying drawings in which, by way of example, are shown some forms of embodiment.

In Figs. 1—3 is shown a mechanism according to the invention for power transmission or gearing, Fig. 1 being a vertical section through the lower part of a crank case for a propelling engine at the same time serving as a gearing case, the section being taken in the line 1—1 in Fig. 2. Fig. 2 is a horizontal longitudinal section taken in the line 2—2 in Fig. 1, and Fig. 3 is a section taken in the line 3—3 in Figs. 1 and 2 on a somewhat enlarged scale. Fig. 4 shows in partial transverse section through the crank case an arrangement through which the propulsion force is taken out from the engine in another direction than in the arrangements according to Figs. 1—3. Fig. 5 is a section taken in the line 5—5 in Fig. 4. Figure 6 shows a method of building up. Figures 7—9 show in side and front elevation and plan view respectively an engine gear unit provided with a power transmission according to the invention, in which unit the propeller shafts leave the engine making a right angle with the longitudinal axis of the engine. Figures 10 and 11 show in rear elevation and plan view respectively a unit in which the propeller shafts leave the engine in the longtiudinal direction of the same.

The two shafts associated with the gearing mechanism, the primary shaft 1 and the secondary shaft 2 conducting the driving force away from the gearing to the driving shafts of the road wheels are, as opposed to what is the case in the known arrangements, directed inwards towards the centre portion of the engine, reckoned in the direction of the engine shaft. The secondary shaft 2 is of course displaced round the intermediate shaft from the position which in the known arrangement is co-axial with the engine shaft 3. The shafts 1 and 2 can be arranged, either at the side of the engine shaft or, as shown in the drawing, below the same and at such a distance from the same that their gear wheels are clear of the path of motion of the cranks but in spite of this as close to the said engine shaft as is possible. This location close to the crank motion takes for granted that there is no need for the shafts to clear a fly-wheel of the usual diameter, i.e. considerably larger than the diameter of the crank motion path. If the diameter of the fly-wheel cannot in a suitable manner

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be reduced so that it does not constitute an objection to the location in question, the driving force should instead be taken out from the end of the engine shaft which is free from a fly-wheel, as is the case in the construction shown. The drive is, in similarity to what is the case in the known arrangements, transmitted from the secondary shaft 2 to the propeller shafts, one of the gear wheels 4 in the bevel drive 4, 5 being located directly on that end of the secondary shaft which is directed towards the middle portion of the engine; the propeller shafts 6, 7 of the wheels will in this case make an angle of 90° with the engine gear unit. The gear wheel 5 is, on account of its large diameter, not placed immediately below the engine shaft but must be located at the side of the same on a transverse shaft 21 located immediately below the path of motion of the cranks and mounted in two bearings 22 and 23 respectively, one in each of the side walls of the gear box 19 with the bearing 22 on one side located immediately outside the gear wheel 5. From this preferably tubular shaft 21 the drive is taken out through the shafts 6 and 7 to the articulate propeller shafts preferably through a differential gearing 36 built together with the shaft 21 and the gear wheel 5.

In order to avoid large and weakening holes in either or both of the side walls, the gear wheel 5 is at the building up not pushed in from the side but inserted from above one end first ready with its shaft in position in which case the holes or seats 25, 26, Fig. 6, adapted for the bearings need not be made larger than what is required due to the size of the bearings and the space for the introduction according to Fig. 6.

In Fig. 6 is illustrated how this introduction of the gear wheel 5 with its shaft is effected, the said parts being shown by dash-dotted lines in inclined position at the introduction. As the holes 25, 26 in this case preferably have a slightly larger diameter than the bearing rings 23, 24 the intermediate space outside these rings is preferably filled up by suitable bushes 27, 28.

It is obvious that in an arrangement of shafts of the gearing in a manner described above the propeller shafts of the driving wheels are arranged so that they extend from the middle portion of the engine, and the engine can thus be placed between the driving wheels and with their imagined common axles running through said middle portion. By such a location of the engine a large free space is further obtained in the vehicle, which space in the known arrangements to a large part is taken up by the gear box.

The compact shape obtained with an engine gear unit according to the invention also enables the same to be placed with its longitudinal axis in the transverse direction of the vehicle and between the driving wheels. In this case the propeller shafts of the driving road wheels run parallel to the engine shaft and still extend from the middle portion of the unit. This is ensured by the fact that instead of the bevel drive 4, 5 a spur wheel drive 8, 9 is employed as appears from Figures 4 and 5. As regards the other parts the arrangement of the gear may be the same in both forms of embodiment.

Referring again to Figures 1 to 3 the secondary shaft 2 supports the spur wheels 12 which are engageable with the spur wheels 11 of the primary shaft 1 and displaceable in a suitable manner by means of selector rods 10 or similar members. If on the shafts 1 and 2 only a few spur wheels 11, 12 are located, there is no difficulty in choosing the length of these shafts so that the propeller shafts for the driving wheels may extend from the middle portion of the engine but when further gear wheels are present it will be necessary to use a different construction involving smaller longitudinal dimensions.

Preferably in this case a gear wheel system is employed in which the spur wheels in the gear wheel pairs are in constant mesh with each other according to Specification No. 13,684/31 (Serial No. 378,393).

The gearing mechanism shown in Figures 1—3 is preferably designed according to the principle described in connection with Specifications Nos. 13,684/31 (Serial No. 378,393) and 13,782/31 (Serial No. 378,426).

Between the engine shaft 3 and its extension the shaft 15, a clutch, for instance a cone friction clutch 16, is arranged. At the end of the shaft 15 a gear wheel 17 is secured, which in an ordinary manner transmits the drive to the primary shaft 1 by means of a gear wheel 18 fixed to the same. By means of the directioning of the shafts 1 and 2, above described, inwards towards the middle portion of the engine, the location of the gear 17, 18 between the shafts 3 and 1 in the one end of the unit, will be particularly easily accessible which has been taken advantage of by mounting these gear wheels freely overhanging outside the main casing 19 and covering them by an easily removable lid 20 so that they can easily be exchanged, and the total overall gear ratio can be adapted to the district in which the vehicle is mostly driven.

As apparent from the above description the driving is always effected through

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gears without any so-called direct drive between the engine shaft and the shafts 1 and 2.

The arrangement in the conventional gear box has largely been dictated by the possibility afforded by the system of connecting the engine shaft and the secondary shaft 2 directly to each other without intermediate gears, a so-called direct drive being obtained on which the main portion of the driving is carried out. The advantages obtained with the direct drive are that the greatest part of the driving will be free from transmission losses and noise due to two gears.

The greater efficiency obtained in this case is however in most cases more than nullified by the resistance afforded by the primary shaft with its wheel constantly rotating in oil whether the adjustable gears are engaged or not. This loss of power is avoided if the gear does not work in a bath of oil, but is supplied with oil under pressure, according to Specification No. 13,158/31 (Serial No. 378,386).

If several gears, for instance four or five, are provided, one of which is a so-called over-speed-gear, in order to reduce the number of revolutions of the engine below that of the secondary shaft, a greater portion than previously of the driving will further be carried out on another gear than the direct one, and the reason for retaining the latter will consequently be less. The over-gear further serves as a counter-balance against the gear loss in the form of increased engine economy.

What is gained in a direct gear as regards decreased noise can also be gained by the introduction of obliquely cut teeth in all places.

The noise from the gear box will further be less irritating in an arrangement according to the invention with the gear box located below the engine in immediate proximity to heavy parts and with a secure mounting along its whole length, than that from a gear box which is only connected to the engine at one end with a large overhang.

The compact construction of the unit is simplified by the fact that the gearing is built into the crank case 19 of the engine, where it is further easily accessible after the engine has been lifted away, if the gearing is located in the bottom half of the divided crank case.

In this crank case 19 designed as gear casing or gear box the total number of shafts are mounted as close to the engine shaft as is permitted by the crank motion.

A thin metal sheet 48, Fig. 3, immediately below the crank motion will however be necessary in order to prevent the oil from the engine flowing down in the gear box particularly if the engine and the gearing employ different oil.

The distance between the engine and gear shafts will thus wholly depend on the size (diameter) of the crank motion and the gear wheels.

The crank motion may be made to occupy the smallest possible place by suitable shaping of its elements, e.g. by rounding off of the connecting rod head 30, Figs. 1 and 3. By employing gear wheels with obliquely cut teeth with relatively great width of the teeth, the diameter of these wheels may be made small. The system with gear wheels sliding against fixed dog clutches, which system is particularly economical as regards the longitudinal dimension of the gearings, enables the use of relatively large tooth widths without the gearing thereby becoming too long. The gear wheel 5 with the differential housing 36 and the transverse shaft 21 should also be disposed as close to the crank motion and as little sideways from said motion as is possible, and should further be built together in a unit in such a manner that the profile of said unit viewed looking along the crank shaft, substantially corresponds to the crank motion. The same holds also in those cases where a worm gear is employed.

As shown also in specification No. 13,158/31 (Serial No. 378,386) the lower half of the divided crank case serving as gear box is at the same time preferably designed as a container for the lubricating oil. This container 35, Figs. 1 and 2, is preferably arranged on that side of the transverse crown wheel shaft 21 which is opposite to the gearing, and separated from the remaining portion of the crank case by a side wall 38, in which, if one of the cranks of the engine shaft be arranged directly above the same, a recess 37 is provided corresponding to the crank motion.

It may further be suitable to divide the container into two chambers, one for the gear oil and one for the engine oil. The previously mentioned metal sheet 48 which is preferably placed above the gearing in order to protect the same from oil splash from the engine preferably extends over the container too, and should then be designed closely to follow the trajectories of the cranks on the shaft.

In Figs. 7—9 an engine gear unit according to the invention is shown in side and front elevation and plan view respectively in which unit the drive is taken out in a direction perpendicular to the longitudinal direction of the engine. The engine is denoted by 40 and the lower

portion of the crank case, at the same time serving as gear casing and oil container, by 19. The propeller shafts 42 of the driving wheels 41 are in this case preferably connected with the transverse driving shafts of the engine by means of articulated connecting members 43.

In Figs. 10 and 11 an engine gear unit is shown in rear elevation and plan view respectively in which the drive is taken out from the gearing in the longitudinal direction of the engine. The gear required in this case between the pinion shaft and the propeller shafts is partly built into a casing 44 projecting from the middle portion of the crank case. An example of an arrangement for this purpose is shown on an enlarged scale in Figs. 4 and 5.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A power transmission for motor vehicles having the engine and encased gearings built together as a unit, wherein the driving power for the driving wheels of the vehicle is transmitted from the middle portion of said unit, reckoned in the direction of the engine crank shaft, characterized by the fact that below or beside the engine shaft or its protraction there are disposed two transmission shafts parallel to the engine shaft, whereby under all driving conditions the driving power from one end of the engine shaft is transmitted to one of said shafts, the primary shaft, and by means of a power transmission, for instance a toothed gearing, provided between said shafts, is transmitted through the other of said shafts, the secondary shaft, and a final pinion to a final gearing located at the middle portion of the engine gear unit, reckoned in the direction of the engine shaft, from which final gearing the engine power is transmitted to external transmission members, the driving shafts and the driving wheels, said final pinion being secured to that end of the said secondary shaft, which is directed inwardly towards the middle portion of the engine gear unit.

2. Arrangement according to claim 1, characterized in that mechanisms for the transmission of the drive from the engine shaft are located at the end of the engine shaft which is free from a fly-wheel.

3. Arrangement according to claim 1, characterized by the fact that a drive, for instance a bevel gear (for example 4, 5), or a worm gear is arranged for the power transmission from the secondary shaft (for example 2) to the driving or propeller shafts, with or without an intermediate differential gear, the propeller shafts forming an angle, preferably a 90° angle with the engine shaft.

4. Arrangement according to claim 3, characterized in that holes (for example 25, 26) are arranged in the sides of the gear box for the bearings of the transversely placed gear wheel which holes are preferably not greater than what is required due to the size of the bearings and the space necessary for the swinging motion at the introduction of the gear wheel and its shaft, for the purpose that the gear wheel and its shaft with or without differential gear may be introduced into the gear box from above.

5. Arrangement according to claim 1, characterized in that for the power transmission from the secondary shaft to the driving or propeller shafts a spur wheel gear or a chain transmission is arranged, with or without an intermediate differential gear, the propeller shafts running at the side of the engine gear unit substantially parallel to the engine shaft.

6. Arrangement according to claims 1 and 3, characterized by the fact that the gearing of the propeller shafts is arranged as close to the engine shafts as the crank motion permits there being preferably no material between the gearing and the crank motion, which in turn is made to take up a small space by suitable shaping of its elements, for instance rounding off of the connecting rod heads.

7. Arrangement according to Claims 1, 3 and 6 in transmission of power from the secondary shaft (for example 2) by means of a final drive comprising a worm wheel or a bevel gear wheel, which is secured to a hollow shaft having a differential gear located within it, to the movable propeller shafts disposed outside said differential gear, said hollow shaft together with the differential gear and the worm or bevel wheel forming a unit and being disposed transversely with respect to the engine shaft and below the crank motion of said shaft, characterised by the fact that the said unit is so designed and shaped that its profile, viewed looking along the crank shaft, to the largest possible degree corresponds to the crank motion.

8. Arrangement according to Claim 1, characterised by the fact that the final drive and the remaining parts of the gearing are as a whole located close to the engine shaft.

9. Arrangement according to any one of the Claims 1 to 4 inclusively, characterised by the fact that for the power transmission between the primary and secondary shafts, a variable gearing mechanism is arranged, which is located wholly

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or partly below or on the side of the engine shaft or its extension, which mechanism, for instance, is of a known type with several different pairs of gear wheels which alternatively are brought to transmit the power, the gear wheels of the secondary shaft (for example 2) preferably being displaceably arranged.

10. Arrangement according to Claim 1, characterised in that the gear wheels (for example 18, 17) arranged for the power transmission between the engine shaft (for example 3) and the intermediate shaft (for example 1) are mounted overhanging, outside the gear casing, and preferably exchangeably mounted on freely supporting pins on the respective shafts.

11. Arrangement according to Claim 1, characterised by a covering sheet (for example 48) placed immediately below the crank path of the engine shaft, and conforming with the shape of the same, which covering sheet is preferably also extended so as to cover the part of the gear casing or gear box accommodating a container arranged for the common or separate oil-supply for the engine and the gear.

12. Arrangement according to any one of the preceding claims, characterised in that the gearing is built into the crank case of the engine, which case is so designed that it at the same time serves as a crank case and gear box.

13. Arrangement according to Claim 12 with a divided crank case, characterised in that the lower half of the crank case is designed as a separately removable gear box in which the main portion of the gearing is built-in.

14. Arrangement according to any one of the preceding claims, characterised in that the lubricating oil required for the gearing by suitable means is brought to circulate between a separate oil container and the gear box, the purpose being to avoid the gearing working in an oil supply.

Dated this 8th day of May, 1931.

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Chartered Patent Agents.

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Fig. 1

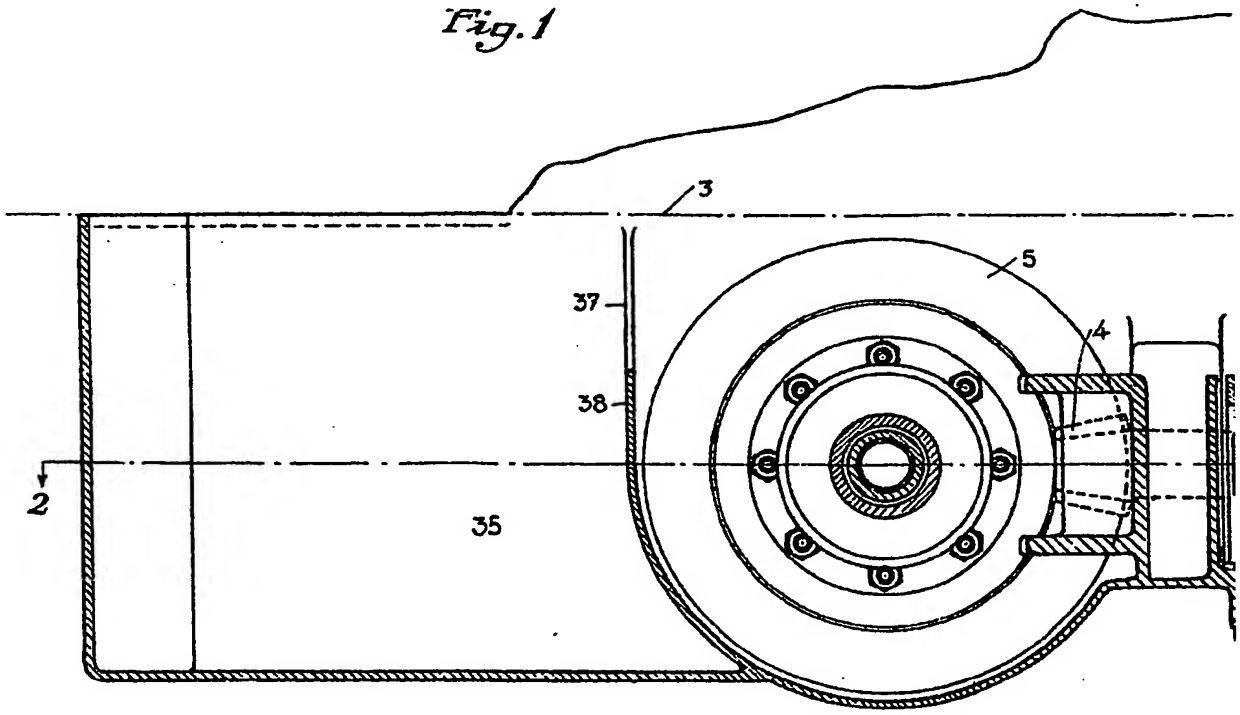
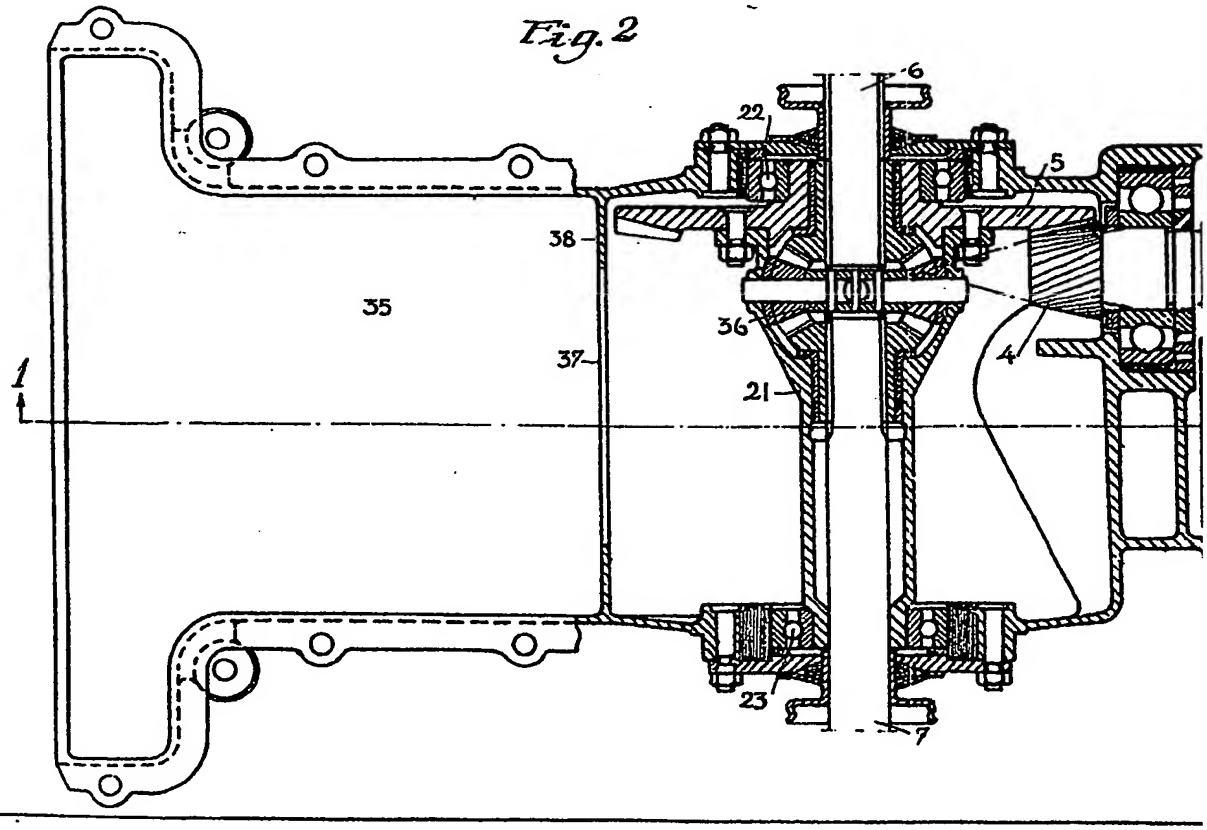


Fig. 2



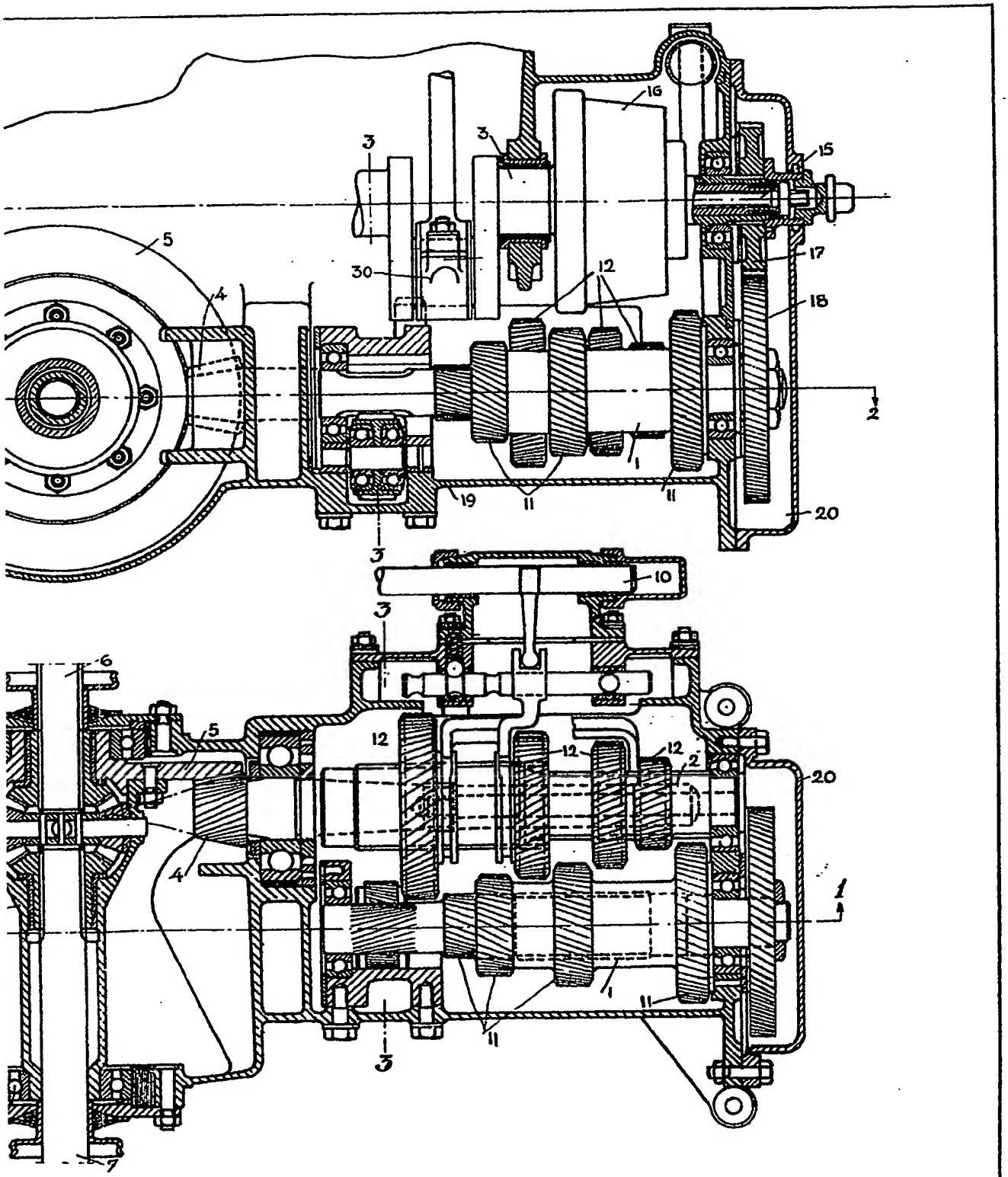


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Fig. 1

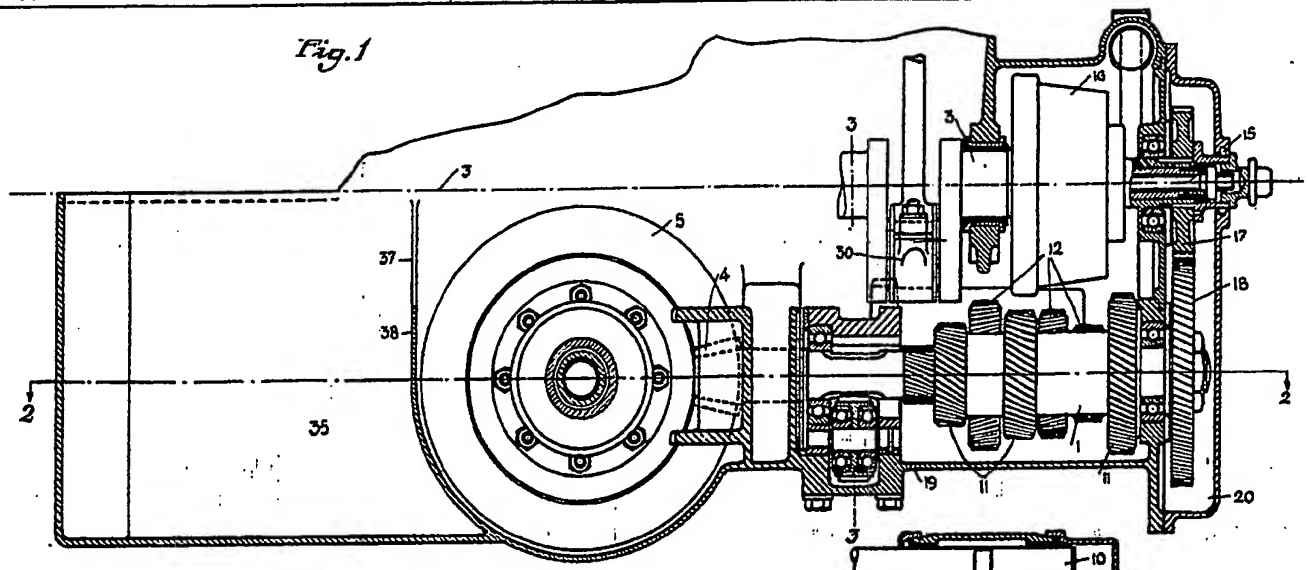

Fig. 2

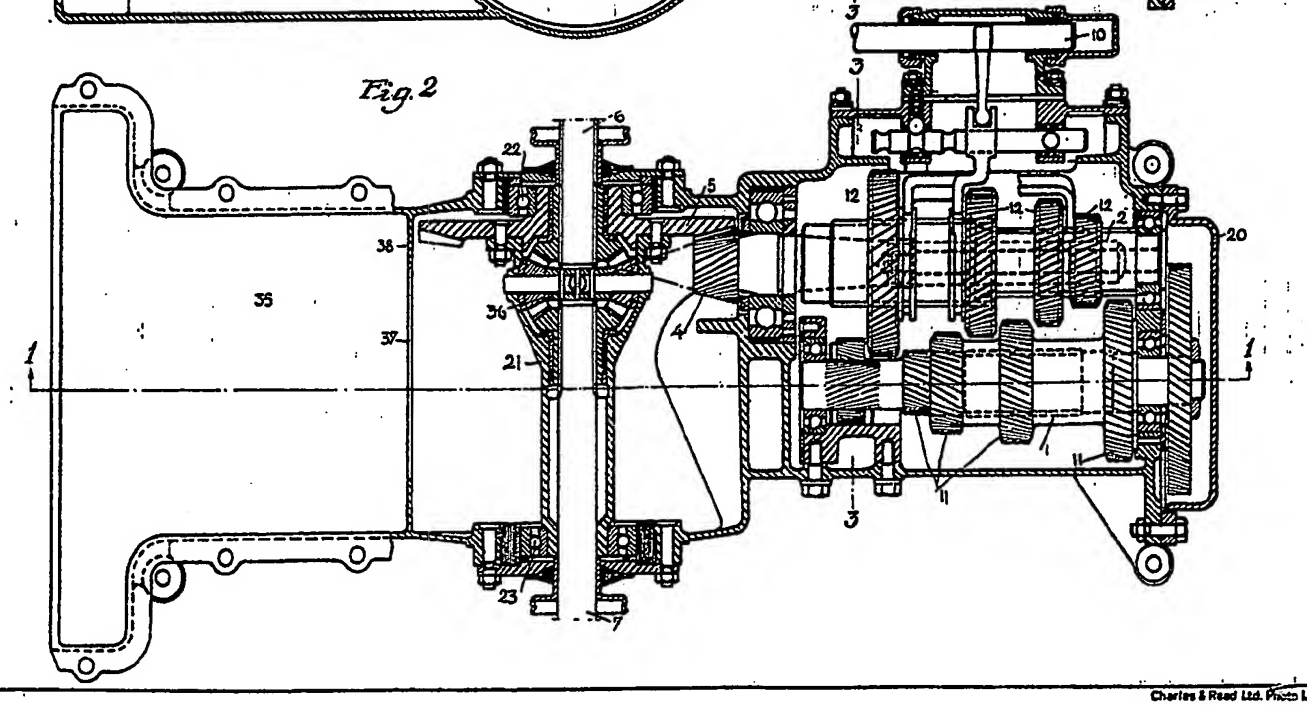

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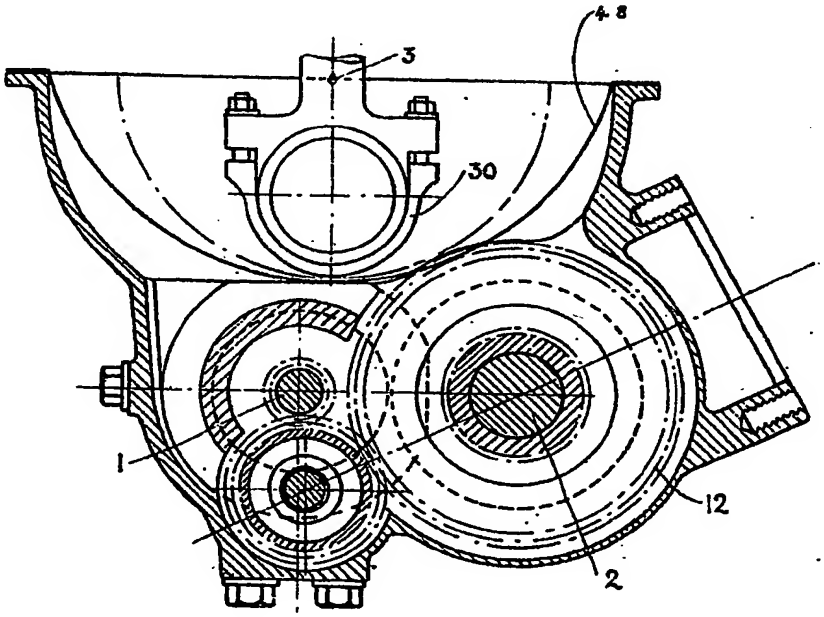
Fig. 3



25
23
27

Fig.6

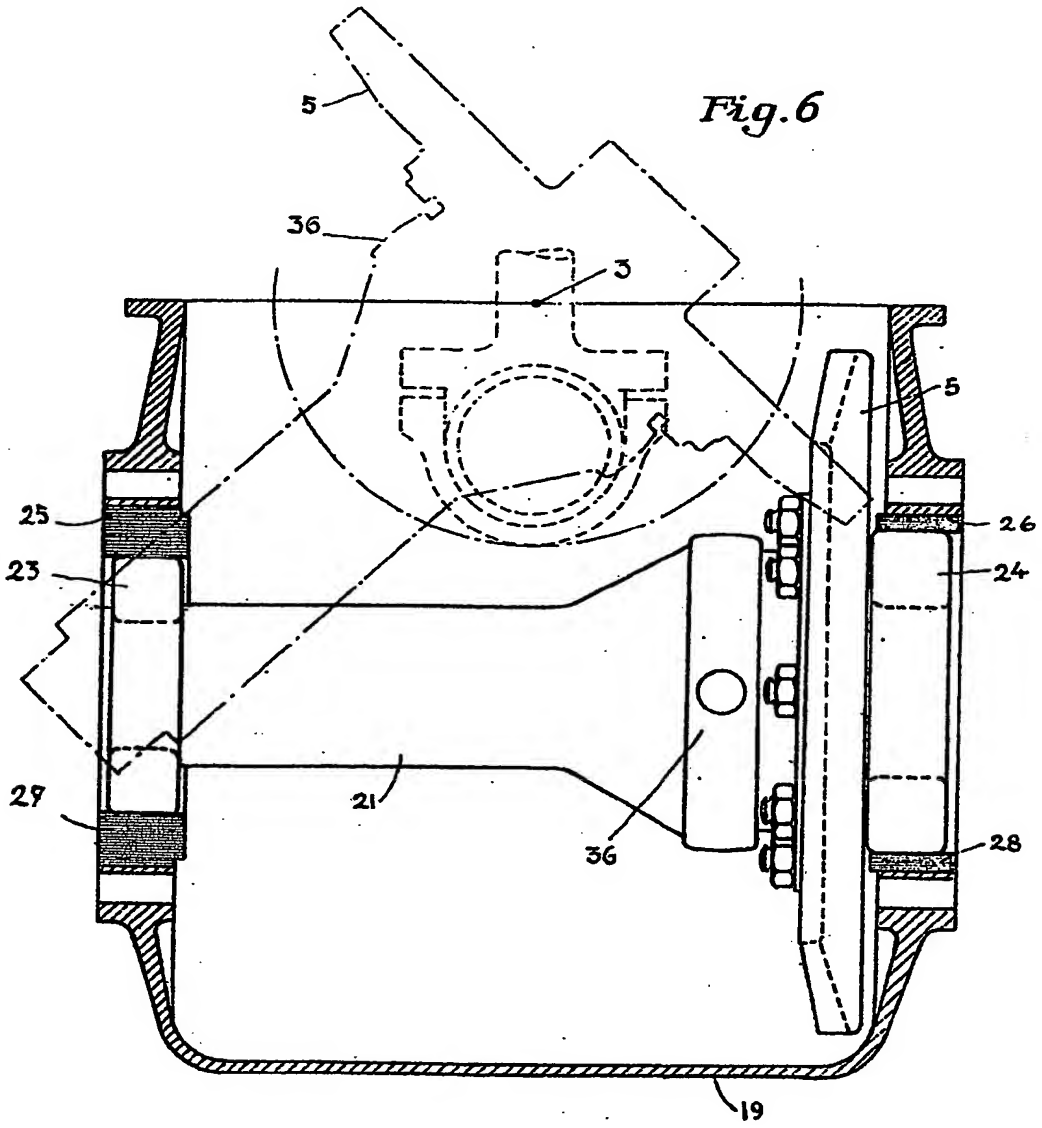


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Fig. 3

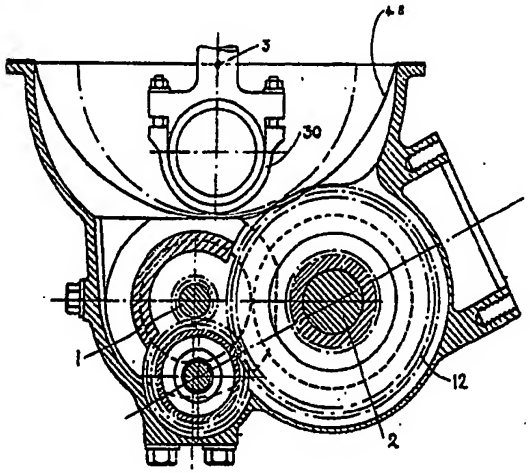

Fig. 6

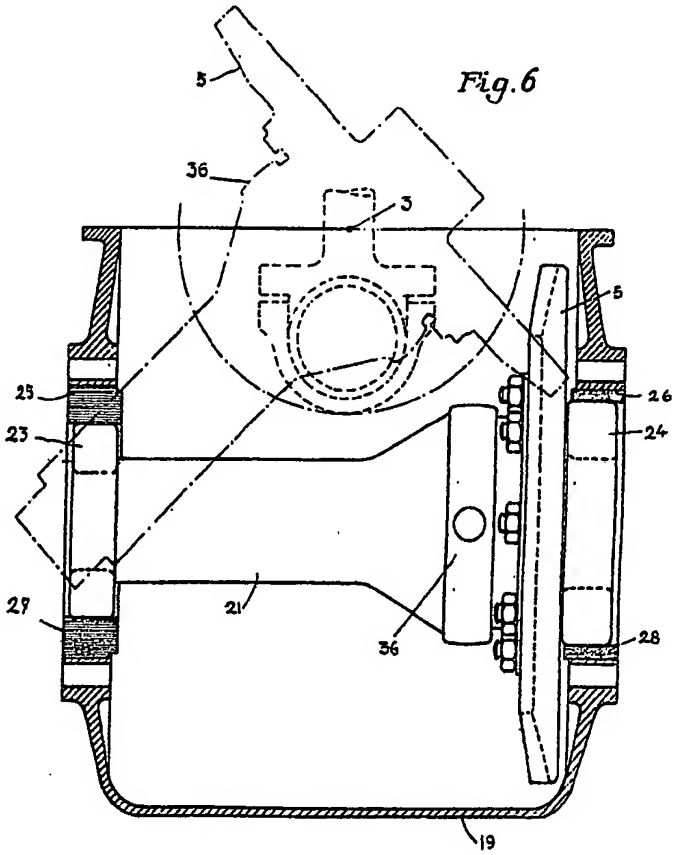

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Fig.4

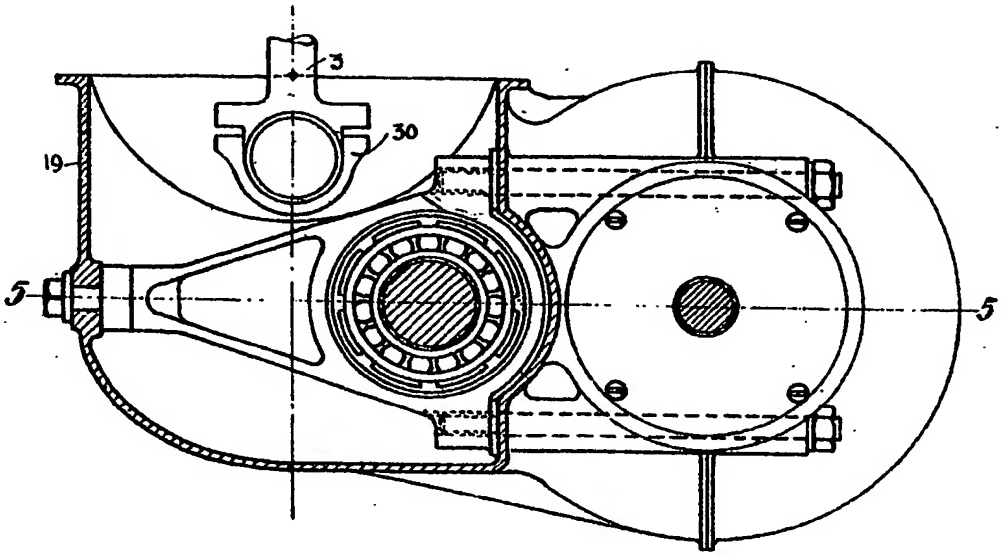

Fig.5

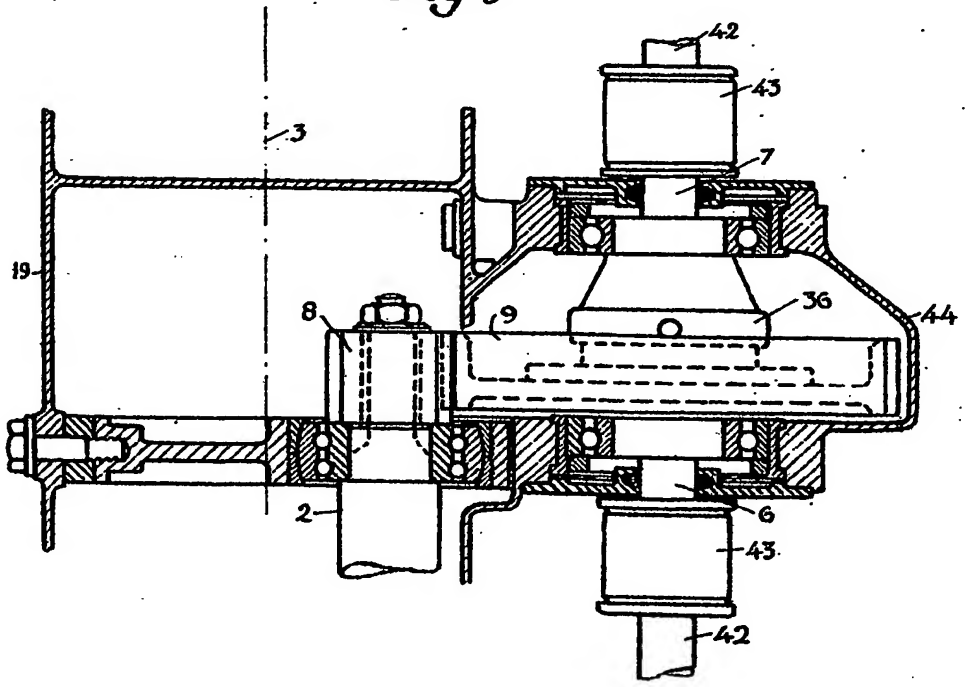

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Fig 7

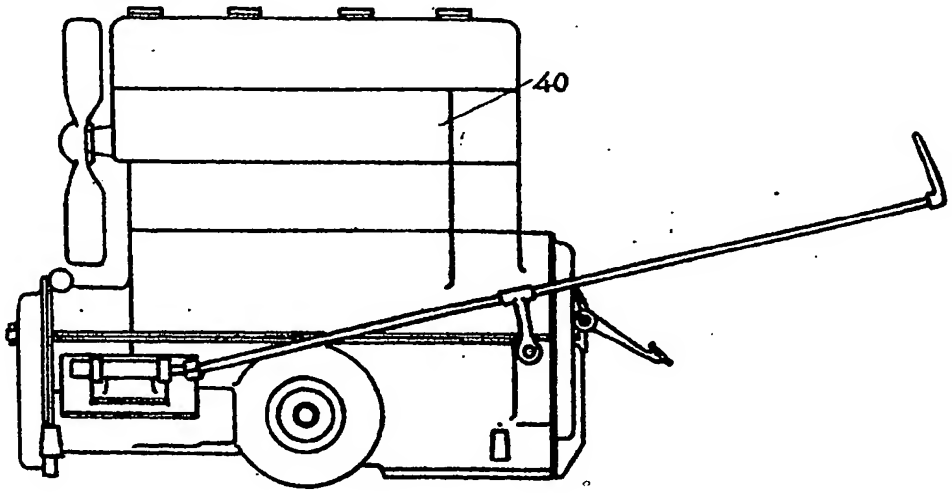
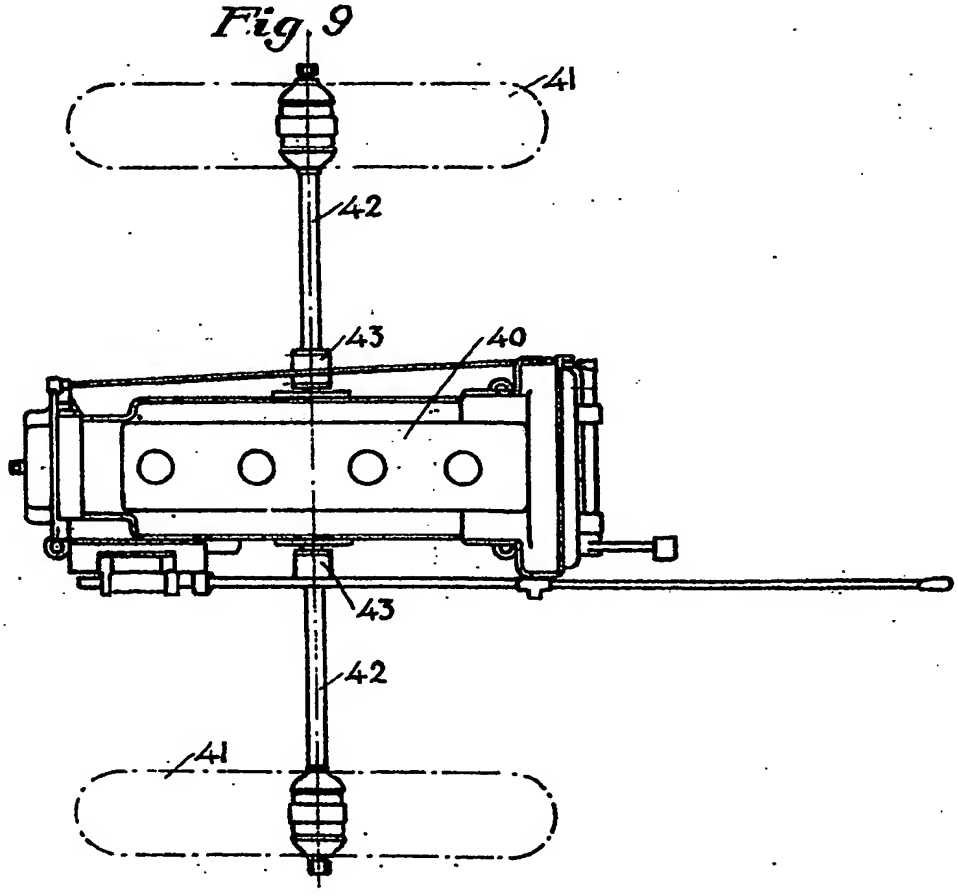


Fig 9



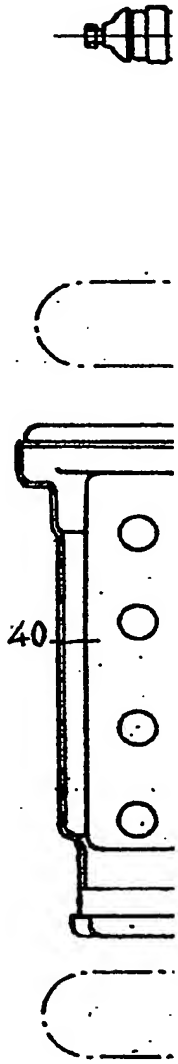


Fig. 8

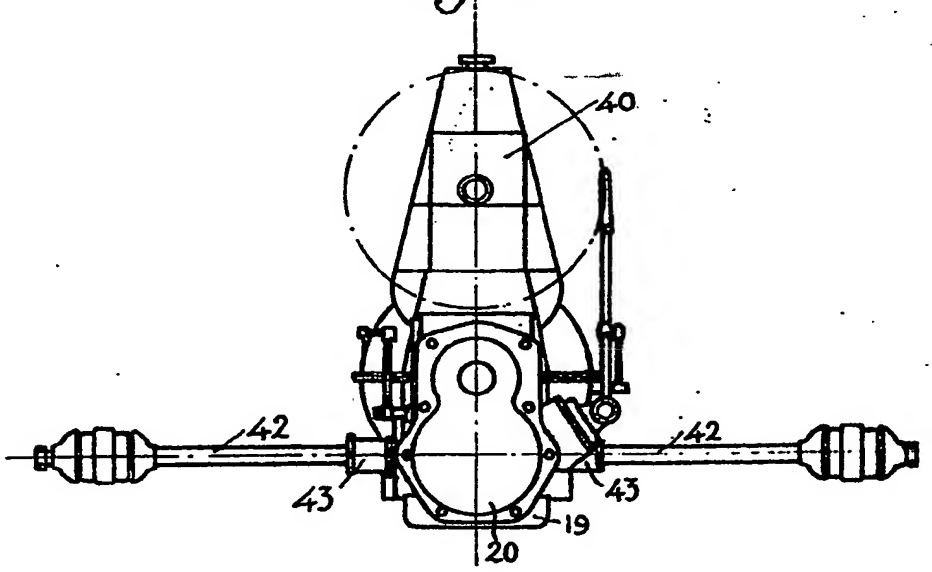


Fig. 11

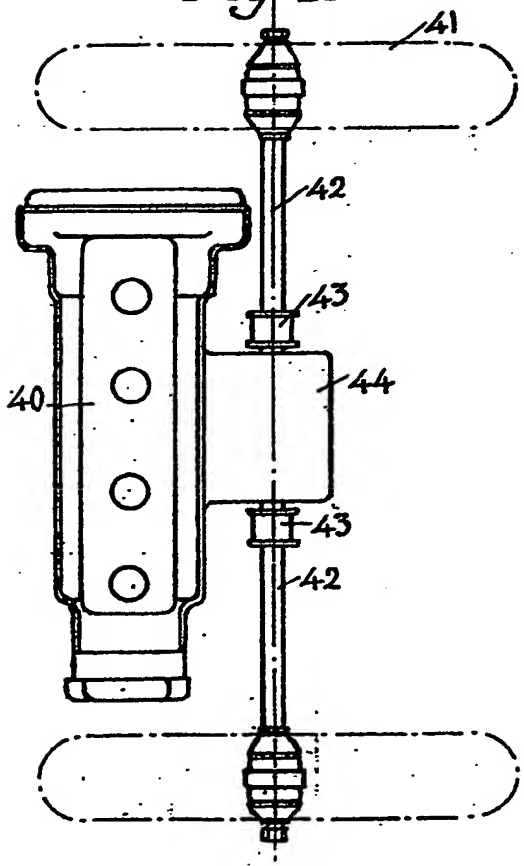


Fig. 10

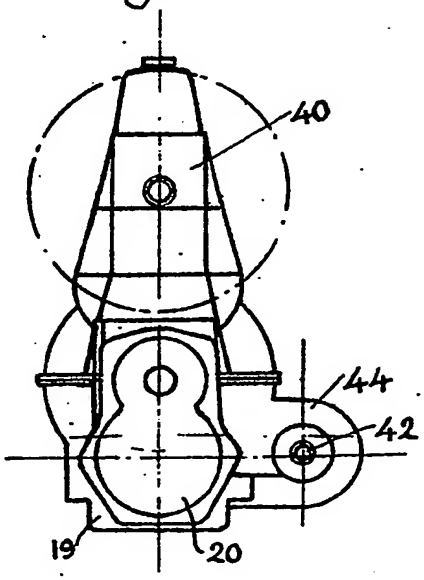


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Fig 7

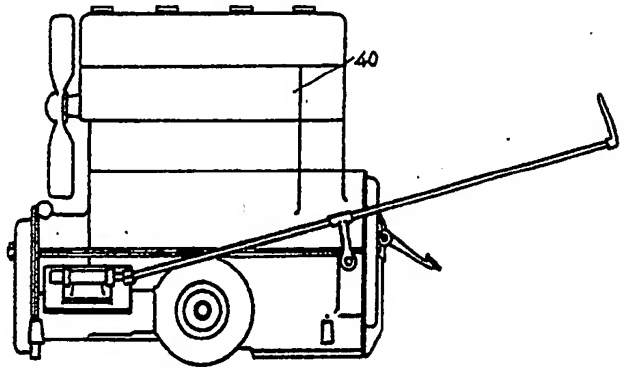


Fig. 8

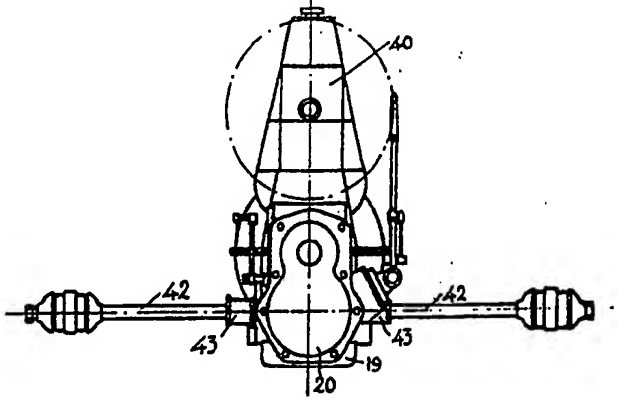


Fig 9

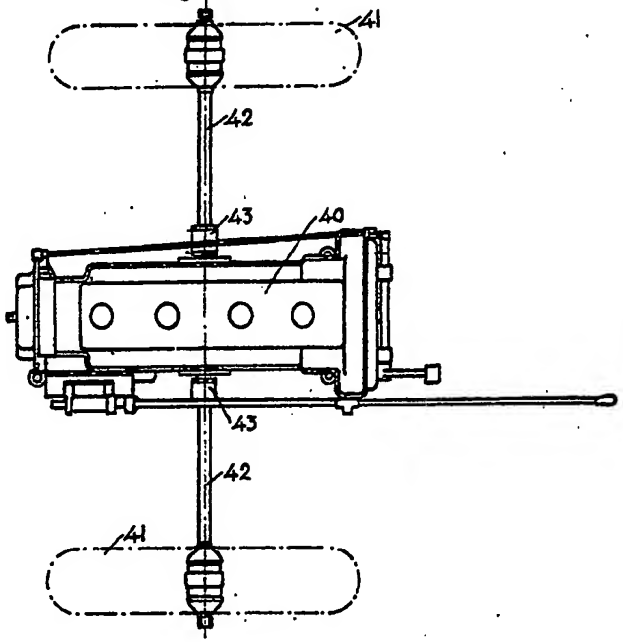


Fig. 11

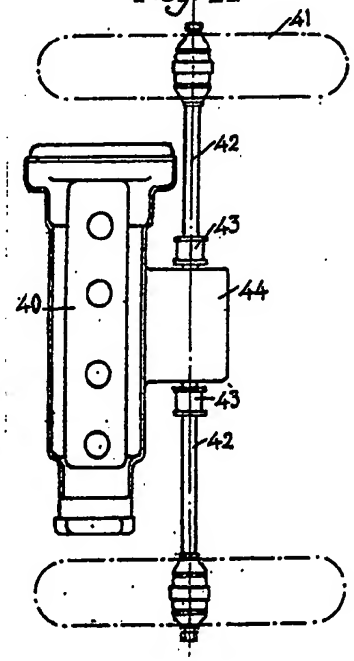
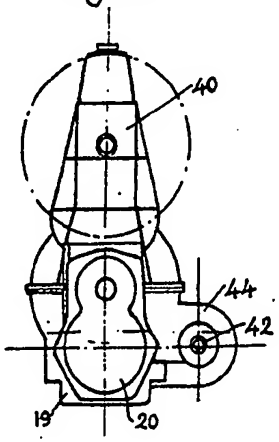


Fig. 10



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